

Claims

1. A process for the conversion of one or more unsaturated hydrocarbons to one or more oxidation products which process comprises reacting one or more unsaturated hydrocarbons in a reaction mixture under oxidation conditions in the presence of an oxidant, a heterogeneous catalyst and a solvent characterised in that the catalyst comprises a Group IVB, VB or VIB metal and that carbon dioxide is present in the reaction mixture.
2. A process as claimed in claim 1 wherein the catalyst is a metal molecular sieve.
3. A process as claimed in claim 1 or claim 2 wherein the metal is a Group IVB metal.
4. A process as claimed in claim 3 wherein the metal is titanium.
5. A process as claimed in any one of claims 1 to 4 wherein the solvent is methanol.
6. A process as claimed in any of the preceding claims wherein the oxidant is hydrogen peroxide.
7. A process as claimed in any one of the preceding claims wherein the unsaturated hydrocarbon is an olefin.
8. A process as claimed in any of the preceding claims wherein the carbon dioxide is present under supercritical conditions.
9. A process as claimed in any of the preceding claims

wherein the oxidation product is one or more epoxides.

- 5 10. A process as claimed in any of claims 1 to 8 wherein the oxidation product is one or more aldehydes, ketones or acids.
- 10 11. A process as claimed in claim 9 comprising an additional step wherein the epoxide is converted to one or more acids or alcohols.
- 15 12. A process as claimed in claim 11 wherein the one or more acids or alcohols are linear acids and linear alcohols.
13. A process as claimed in any of the preceding claims wherein the ratio of solvent to unsaturated hydrocarbon is less than 8:1.
- 20 14. A process as claimed in claim 13 wherein the ratio is 1:1 or less.
- 25 15. A process as claimed in any of the preceding claims wherein the reaction mixture comprises at least 1% by weight of carbon dioxide.
- 30 16. A process as claimed in claim 15 wherein the reaction mixture comprises at least 25% by weight of carbon dioxide.
- 35 17. A process as claimed in any of the preceding claims wherein the carbon dioxide constitutes more than 50% by weight of the solvent used in the reaction mixture.
18. A process according to any one of claims 4 to 17 wherein the catalyst is selected from one of the

following: TS-1, TS-2, TS-3, titanium zeolite beta, TS-48, titanium mordenite and titanium silicalite.

- 5 19. A process according to any of claims 1 to 18 wherein the reaction residence time is at least 20% less than that required to achieve 50% conversion without the presence of carbon dioxide.
- 10 20. A process according to claim 19 wherein the reaction residence time is at least 50% less.
21. A process according to either claim 20 or claim 21 wherein the conversion is 90%.
- 15 22. A process as claimed in any of the preceding claims wherein the reaction pressure is between 1 and 700 atmospheres.
- 20 23. A process as claimed in any of the preceding claims wherein the epoxidation reaction temperature is from 0°C to 100°C.
- 25 24. A process as claimed in claim 23 wherein the reaction temperature is within the range 40°C to 80°C.
25. A process as claimed in any of the preceding claims wherein the reaction residence time is within the range 10 minutes to 48 hours.